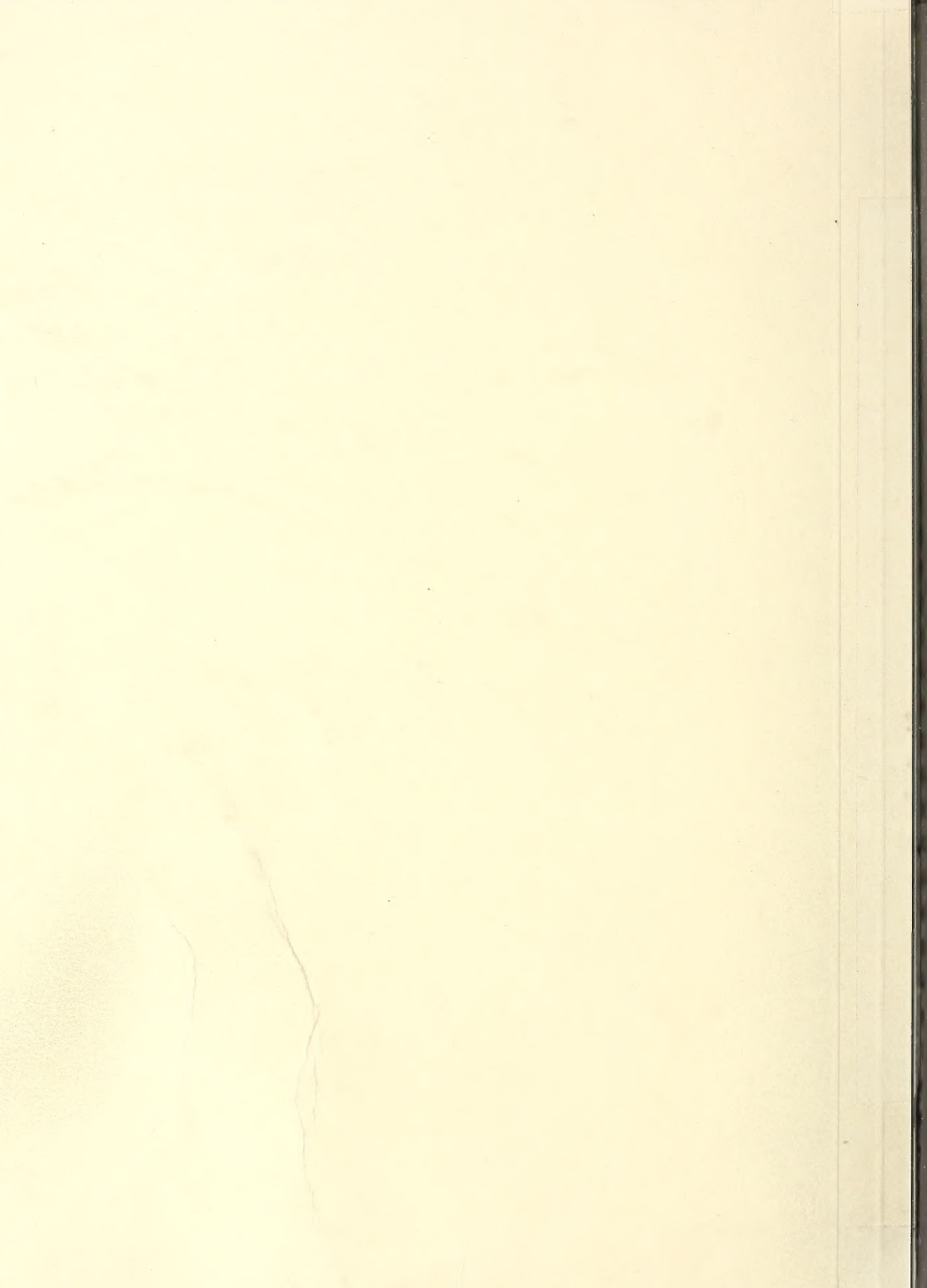


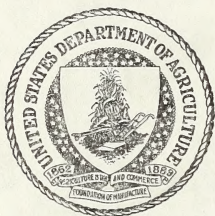
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Reaction of Varieties and Selections of Hard Red Winter Wheat to Bunt
In Uniform Bunt Nurseries (1943-1954) ^{1/}

C. O. Johnston and L. P. Reitz ^{2/}

Uniform bunt nurseries have been grown annually at several agricultural experiment stations in central United States as a part of the hard red winter wheat improvement program since 1931. Annual reports of the results have been prepared in mimeographed form and distributed to co-operators and others. Summaries covering periods of about 5 years each have been prepared. The data for three preceding periods, 1932-37, 1938-42, and 1943-47 have been published (3, 4, 5). This constitutes the fourth report and summarizes the data recorded at from 4 to 7 stations each year during the 7-year period, 1948-54.

1/ Cooperative investigations of Field Crops Research Branch, A.R.S., U.S.D.A., and the agricultural experiment stations of Texas, Oklahoma, Kansas, Nebraska, Colorado, and Montana. Contribution No. 603, serial No. Department of Botany and Plant Pathology, Kansas, Agr. Exp. Sta., Manhattan.

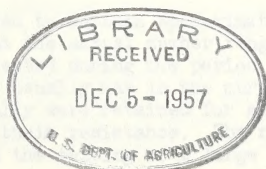
2/ Pathologist and Senior Agronomist, Field Crops Research Branch, A.R.S., U.S.D.A. The authors express their appreciation to cooperators at the various experiment stations for growing the nurseries and furnishing seed and data.

3/ Johnston, C. O., Quisenberry, K. S., and Reitz, L. P. Reaction of hard red winter wheats to bunt in uniform bunt nurseries, (1943-47). Agron. Jour. 43: 61-66. 1951.

4/ Quisenberry, K. S., Rodenhiser, H. A., and Johnston, C. O. Bunt reaction of hard red winter wheats in 1938-42. Jour. Amer. Soc. Agron. 37: 514-522. 1945.

5/ Rodenhiser, H. A., and Quisenberry, K. S. Bunt reaction of some varieties of hard red winter wheat. Jour. Amer. Soc. Agron. 30: 484-492. 1938.

Plant Industry Station
Beltsville, Maryland
359CC August 1955



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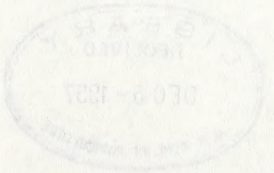
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Materials and Methods

The seed of most of the varieties and selections tested each year was grown at the various agricultural experiment stations in the hard red winter wheat area. Wheat breeders and others asking for inclusion of varieties and promising hybrid lines were required to furnish seed of the strains suggested. Seed of the check varieties was usually grown at the Kansas or Nebraska Agricultural Experiment Stations with the exception of that of Ridit C.I. 6703 ⁹ and Relief C.I. 10082 which were obtained from the

6/ C.I. refers to accession number of Cereal Crops Section, U.S.D.A.

Washington Agricultural Experiment Station and that of Wasatch C.I. 11925 which was obtained from the Montana Agricultural Experiment Station. Nine varieties were included in the uniform nurseries each year as checks. These were Cheyenne (C.I. 8885), Kharkof (C.I. 11442), and RedChief (C.I. 12109) susceptible to most races, Hussar (C.I. 4843), Minturki (C.I. 6155), and Oro (C.I. 8220) resistant to some races and susceptible to others, and Ridit (C.I. 6703), Relief (C.I. 10082), and Wasatch (C.I. 11925) highly resistant to most races. These were distributed at suitable intervals through the nurseries each year.

In 1948 and 1949 the seed was inoculated before sowing with composite inoculum of physiologic races known to be prevalent in the states in which the nurseries were grown. The races were supplied by C. S. Holton of the Washington Agricultural Experiment Station. Inoculum of races of Tilletia foetida (Wallr.) Liro was used at all stations except Bozeman, Mont., where races of both T. foetida and T. caries (D.C.) Tul. were used. Clean seed was inoculated with the proper composites at Lincoln, Nebr., then shipped to the various stations for sowing. The races used were as follows: Denton, Tex., L2; L3; L4; L5; L10; Stillwater, Okla., L3, L4, L5, L7; L10; Manhattan, Kans., L3, L5, L7; Lincoln and North Platte, Nebr., L2, L3, L7; Fort Collins, Colo., L3, L8, L10; and Bozeman, Mont., L2, L3, L4, L8, T3, T6, T8, T11.

Beginning in 1950 seed was inoculated with a composite of collections of bunt made in the state or area each station represented.

The nurseries were planned to contain approximately 50 varieties or selections each year, but the actual number ranged from 45 to 59. A total of 146 selections were tested during the period 1948-54. A selection that proved to be susceptible usually was in the nursery only one year, but resistant varieties usually were retained for at least 3 years to obtain a very thorough test of their resistance. The rapid elimination of susceptible lines permitted the testing of a large number of selections in a relatively short time.

The seed was sown in duplicate rows at each station. At most stations both replications were sown on the same date but at Stillwater, Okla., one was sown early and the other later in the fall. The replication having the heaviest infection was selected as representative for the station in calculating annual averages.

In addition, a dwarf bunt nursery was sown in soil known to be naturally contaminated with dwarf bunt at Spring Hill, Mont. each year except 1949. Clean seed of the varieties and selections in the common bunt nursery was sown. The results from this nursery were not entirely satisfactory. In 1951 and 1952 there was very severe loss of plants from snow mold. Damage was so severe in 1952 that no dwarf bunt readings were possible. In most of the other years the bunt did not exceed 22 to 25 percent in the Kharkof check and was still lower in most experimental rows, making it extremely difficult to measure real resistance. Also the dwarf bunt infection of certain varieties fluctuated widely from year to year. For example, RedChief had 50 percent dwarf bunt in 1950 but only 10 percent in 1953.

In view of the uncertain results with dwarf bunt arrangements were made with C. S. Holton, Pullman, Wash., to obtain inoculum of common bunt race T16, which attacks the varieties that are susceptible to dwarf bunt. A special list of 40 varieties was inoculated with T16 and sown at Spring Hill, Mont. in 1951 and another group of 55 specially selected varieties and selections was inoculated in 1954. This gave more satisfactory results than did the dwarf bunt tests.

Results with Common Bunt

The results obtained for the common bunt nurseries are presented in table 1. It is obvious that a large percentage of the T16 selections tested had considerable resistance to common bunt. Three selections of Marquillo-Oro x Oro-Turkey-Florence and one of Nebred x C.I. 12250 had no infection

7/ C.I. 12250 = a selection of (Turkey-Florence x Fortyfold-Federation) x ((Oro-Turkey-Florence) x (Oro x Fortyfold-Federation)).

although each was grown only in a single year. Twenty-six additional selections had average infections of only a trace. Ten of those were grown for 2 or 3 years. Thus a total of 30 selections had less than one percent infection. Wasatch (C.I. 11925) was the most resistant of the resistant check varieties with an average infection of only a trace for the 5 years in which it was grown. On the basis of the relative percentage of infection in comparison with Kharkof, 15 selections were as resistant as or more resistant than Wasatch. Forty-nine selections were more resistant than

Table 1. Summary of bunt infection of varieties and selections of winter wheat grown in uniform winter wheat bunt nurseries in the Great Plains area, 1948-1954.

| | C.I. or state no. | Percentage bunt infection | | | | | | Wb. Av. | Percent age of Kharkof |
|--|----------------------|---------------------------|------|------|------|------|------|------------|------------------------------|
| | | 1948 | 1949 | 1950 | 1951 | 1952 | 1953 | 1954 | |
| Mgo.-Oro x Oro-Turk.-Flor. | C.I.12937 | - | 0 | - | - | - | - | 0 | 0 |
| Mgo.-Oro x Oro-Turk.-Flor. | C.I.12938 | - | 0 | - | - | - | - | 0 | 0 |
| Mgo.-Oro x Oro-Turk.-Flor. | C.I.12939 | - | 0 | - | - | - | - | 0 | 0 |
| Nebred x C.I. 12250 | N 522126 | - | - | - | - | - | - | 0 | 0 |
| Comanche x C.I. 12250 | N 50 J1129 | - | - | - | - | T | - | T | 0 |
| Nebred x C.I. 12250 | N 52 2121 | - | - | - | - | - | - | T | 0 |
| Yogo x Rescue | Mt 56-30 | - | - | - | - | - | - | T | 0 |
| Mgo.-Oro x Oro-Turk.-Flor. | C.I.12865 | - | - | - | 0 | T | 0 | - | 0 |
| Ridit x Kharkof | Mt 11 B | - | - | T | - | - | - | T | 0.2 |
| Yogo x Wasatch | Mt 9 | - | - | 0 | - | T | - | T | 0.2 |
| Oro x Oro-Turk.-Flor. | C.I.12866 | - | - | - | 0 | T | T | - | 0.2 |
| Comanche x C.I. 12250 | W 52 1126 | - | - | - | - | - | - | T | 0.3 |
| Comanche x C.I. 12250 | C.I.13013 | - | - | - | - | - | - | T | 0.3 |
| Nebred x C.I. 12250 | N 52 2123 | - | - | - | - | - | - | T | 0.3 |
| Pawnee x C.I. 12250 | C.I.13010 | - | - | - | - | - | - | T | 0.3 |
| Wasatch | C.I.11925 | - | - | T | 1 | T | T | T | 0.3 |
| Mgo.-Oro x Hus.-Hohen. | K 47 B 66 | - | T | - | - | - | - | T | 0.4 |
| Ridit x Kharkof | Mt 5 B | - | - | T | - | - | - | T | 0.4 |
| Yogo x Wasatch | Mt 10 | - | - | T | - | - | - | T | 0.4 |
| Mgo.-Oro x Hus.-Hohen. | K 47 B 52 | T | T | - | - | - | - | T | 0.4 |
| Comanche x C.I. 12250 | N 50 J 1067 | - | - | - | - | T | - | T | 0.5 |
| Turkey x Oro | Mt 208 | - | T | T | - | - | - | T | 0.5 |
| Oro x Oro-Turk.-Flor. | C.I.12942 | - | T | 0 | T | - | - | T | 0.5 |
| Pawnee x C.I. 12250 | C.I.13012 | - | - | - | - | - | - | T | 0.6 |
| Oro x Oro-Turk.-Flor. | C.I.12941 | T | T | - | - | - | - | T | 0.7 |
| Wheat-Rye-A. elong. x Chey. | C.I.13114 | - | - | - | - | - | T | 1 | 0.7 |
| Yogo x Rescue | Mt 47-3 | - | - | - | - | - | - | 1 | 0.8 |
| Nebred x C.I. 12250 | N 50 J 447 | - | - | - | - | 1 | - | 1 | 0.9 |
| Nebred x C.I. 12250 | N 50 J 1323 | - | - | - | - | 1 | - | 1 | 0.9 |
| Mint. x Tint. Vulg. ² | C.I.12806 | - | - | - | - | - | - | 1 | 0.9 |
| Mgo.-Oro x Oro-Turk.-Flor. | C.I.12723 | T | T | 1 | 1 | T | - | T | 1.0 |
| Yogo x Wasatch | M 11 | - | - | 1 | - | - | - | 1 | 1.0 |
| Mgo.-Oro x Oro-Turk.-Flor. | C.I.12722 | 1 | T | T | T | - | - | T | 1.1 |
| Turkey x Oro | M 216 | - | T | 1 | - | - | - | T | 1.1 |
| Turkey x Oro | C.I.12705 | - | 1 | T | - | - | - | T | 1.1 |
| Mgo.-Oro x Pawnee | K 462664 | - | T | - | - | - | - | T | 1.2 |
| Comanche x Oro-Turk.-Flor. | C.I.12725 | - | - | 1 | T | - | - | 1 | 1.2 |
| Mgo.-Oro x Oro-Turk.-Flor. | N 491160 | - | - | - | 1 | - | - | 1 | 1.4 |
| Comanche x Blkhl.-Hd.Fed. | W 43 h 2-187 | - | - | - | 2 | T | - | 1 | 1.4 |
| Pawnee x C.I. 12250 | C.I.13009 | - | - | - | - | - | - | 1 | 1.5 |
| Turkey x Oro | Mt 205 | - | T | 1 | 1 | - | - | 1 | 1.5 |
| (Mgo.-Oro x Oro-Tq.) x Med.- Hope-Pn. | C.I.12868 | - | - | - | T | 1 | 1 | 1 | 1.6 |

8/ K=Kans., M=Minn., Mt.=Montana, N=Nebr., NP=North Platte, Nebr., St=Stillwater, Okla.,
T=Texas, W=Woodward, Okla., RN=Manhattan, Kans. rust nursery.

Table 1 (Continued)

| Variety or cross | C.I. or state no. | 1948 | 1949 | 1950 | 1951 | 1952 | 1953 | 1954 | Wt. Av. | Percent age of Kharkof |
|--|----------------------|------|------|------|------|------|------|------|------------|------------------------------|
| Turkey x Oro | C.I.12705 | - | - | - | 1 | 1 | - | - | 1 | 1.8 |
| Turkey x Oro | Mt 201 | - | 1 | 1 | - | - | - | - | 1 | 1.9 |
| Cheyenne x C.I. 12250 | N 522108 | - | - | - | - | - | - | 1 | 1 | 2.0 |
| Mqo.-Oro x Oro-Turk.-Flor. | K 47 B 7 | 1 | - | - | - | - | - | - | 1 | 2.0 |
| Pawnee x C.I. 12250 | C.I.13011 | - | - | - | - | - | - | 1 | 1 | 2.2 |
| Mqo.-Oro x Hus.-Hohen. | C.I.12724 | - | - | 2 | T | - | - | - | 1 | 2.2 |
| Ridit x Kharkof | C.I.12521 | - | - | T | 3 | - | - | - | 1 | 2.4 |
| Wichita-Hybl-Mint ² x Mint.- Tq.-Kh. | C.I.12867 | - | - | - | 1 | 2 | 2 | - | 2 | 2.8 |
| Mqo.-Oro x Oro-Turk.-Flor. | C.I.12721 | 1 | T | - | - | - | - | - | 2 | 2.9 |
| Ridit | C.I.6703 | 4 | 3 | 1 | T | 1 | 1 | 1 | 2 | 3.6 |
| Mint. x timo.-Vulg. ² | C.I.12806 | - | - | - | - | - | 5 | 1 | 3 | 4.1 |
| Hybl-Minhardi x Marmin | M 2785 | - | 1 | - | - | - | - | - | 1 | 4.3 |
| IV Cl.-Com. x Pn.-Com. | K 472941 | - | - | - | - | - | 4 | 3 | 4 | 5.0 |
| Mqo.-Oro x Pawnee | K 462266 | - | - | 4 | 1 | - | - | - | 3 | 6.3 |
| Martin x Tenmarq ³ | C.I.11824 | - | 2 | - | - | - | - | - | 2 | 6.3 |
| Martin x Tenmarq ³ | C.I.11804 | - | 2 | - | - | - | - | - | 2 | 7.4 |
| Chey.-R.Ch. x Pn.-Mqo.-Oro | N 521455 | - | - | - | - | - | - | 5 | 5 | 7.9 |
| Chey.-R.Ch. x Pn.-Mqo.-Oro | N 521458 | - | - | - | - | - | - | 5 | 5 | 7.9 |
| Mqo.-Oro x Pawnee | K 462681 | - | - | - | 5 | - | - | - | 5 | 8.2 |
| Timstein x Mqo.-Oro-Kv.-Tq. | St 516669 | - | - | - | - | - | - | 7 | 7 | 10.0 |
| Compound Hyb. x Mqo.-Oro | N 502984 | - | - | - | - | - | - | 7 | 7 | 10.4 |
| Mqo.-Oro x Pawnee | K 462708 | - | 3 | - | - | - | - | - | 3 | 10.5 |
| Wichita x (Mqo.-Oro-Kv.-Tq.) | 51 H 2042 | - | - | - | - | 4 | 13 | 6 | 8 | 12.0 |
| Mqo.-Oro x Oro-Turk.-Flor. | NP 48500 | - | - | 7 | 6 | - | - | - | 7 | 13.1 |
| Pawnee x C.I. 12250 | N 522145 | - | - | - | - | - | - | 9 | 9 | 13.1 |
| Relief | C.I.10082 | 5 | T | 1 | 13 | 9 | 10 | 14 | 7 | 14.0 |
| Chiefkan x Oro-Tq. | C.I.12518 | - | 4 | - | - | - | - | - | 4 | 14.4 |
| Hope x Mint. ² | C.I.12506 | - | 4 | - | - | - | - | - | 4 | 15.2 |
| Hussar | C.I.4843 | 5 | T | 2 | 7 | 7 | 16 | 20 | 8 | 15.6 |
| 29-34-275 Doublecross | C.I.12511 | - | 1 | 12 | 7 | - | - | - | 7 | 15.8 |
| Turkey x Chey. | C.I.12711 | - | 1 | 12 | 4 | 10 | 15 | - | 9 | 16.7 |
| Mqo.-Oro x Oro-Tenmarq | C.I.12406 | - | - | 11 | 4 | 10 | - | - | 9 | 16.8 |
| Martin x Tenmarq x Kharkof | C.I.12147 | - | 4 | - | - | - | - | - | 4 | 17.1 |
| Blackhull-Oro x Pawnee | C.I.12709 | - | - | - | 13 | 7 | - | - | 10 | 17.2 |
| Med.-Hope x Pawnee ² | K 263 | - | - | - | - | 10 | - | - | 10 | 17.2 |
| Mqo.-Oro x Comanche | K 431646 | - | - | 6 | 14 | - | - | - | 9 | 17.6 |
| Mqo.-Oro x Oro-Tq. | C.I.12854 | - | - | - | 12 | 10 | 12 | 1 | 11 | 17.7 |
| Comanche x Blkh.-Hd.-Fed. | C.I.12710 | 12 | 3 | 12 | 6 | 10 | 9 | - | 9 | 18.1 |
| Oro x Blkh.-Hd.-Fed. | W 4442-42 | - | - | - | - | T | 14 | 23 | 12 | 18.8 |
| Blackhull-Oro x Pawnee | W 434h-89 | 9 | 3 | - | - | - | - | - | 6 | 20.5 |
| Hope-Turk. x Cheyenne | N 436333 | 10 | 1 | - | - | - | - | - | 6 | 20.5 |
| Oro | C.I.8220 | 10 | 2 | 12 | 13 | 10 | 15 | 13 | 10 | 20.6 |
| Hope-Turk. x Turk. | K 44762 | 6 | - | - | - | - | - | - | 6 | 21.1 |
| Mqo.-Oro x Pawnee | 45 RN 2024 | 8 | 3 | - | - | - | - | - | 6 | 21.2 |
| Med.-Hope x Pawnee ² | C.I.12873 | - | - | - | - | 7 | 22 | 11 | 14 | 21.3 |
| Hybl-Minhardi x Marmin | C.I.12508 | - | 6 | - | - | - | - | - | 6 | 21.8 |
| Nebred | C.I.10094 | 7 | - | - | - | - | - | - | 7 | 22.1 |
| Oro x Med.-Hope | C.I.12460 | 7 | - | - | - | - | - | - | 7 | 23.1 |
| Mqo.-Oro x Oro-Tq. | K 431413 | - | - | - | 17 | 11 | - | - | 13 | 23.8 |
| Hard Federation Hybrid | C.I.12515 | 12 | 1 | - | - | - | - | - | 7 | 24.5 |
| Blackhull-Oro x Pawnee | C.I.12516 | 11 | 3 | - | - | - | - | - | 7 | 24.8 |

Table 1 (Continued)

| Variety or cross | C.I. or state no. | 1948 | 1949 | 1950 | 1951 | 1952 | 1953 | 1954 | Wt. Av. | Percent age of Kharkof |
|--|----------------------|------|------|------|------|------|------|------|------------|------------------------------|
| Quanah | C.I.12145 | 11 | 3 | 13 | 12 | - | - | - | 10 | 25.0 |
| 275 Doublecross | C.I.12504 | 12 | 3 | 12 | - | - | - | - | 9 | 25.4 |
| Kv.-Hd.-Fed.-Tq. x Com.- Hope-Hus. | St 516815 | - | - | - | - | - | - | 17 | 17 | 26.6 |
| H44 x Minturki ⁴ | M 2844 | - | - | - | - | - | - | 17 | 17 | 26.7 |
| Mqo.-Oro x E.Blkh.-Hus. | 51 H 2013 | - | - | - | - | 15 | - | - | 15 | 27.1 |
| Nebred x Mqo.-Oro | N 483642 | - | - | - | 15 | - | - | - | 15 | 27.3 |
| H44-Mint.xKd.-Hd.Fed.-Tq. | M 44-67 | - | - | - | - | - | - | 18 | 18 | 28.1 |
| (Mqo.-Oro x Oro-Turk.-Flor.) x H44-Mint. ² | F.C. 1198 | - | - | - | 16 | - | - | - | 16 | 28.2 |
| Comanche x Chey.-Blkh. | C.I.12708 | 13 | 8 | 15 | 12 | 11 | - | - | 12 | 28.4 |
| Hungarian sel. x Nebred | C.I.12507 | - | - | 16 | 15 | 14 | - | - | 15 | 28.4 |
| E.Blkh.-Tq. x Oro-Med.-Hope | C.I.12871 | - | - | 13 | 13 | 13 | 19 | 28 | 17 | 28.5 |
| Concho | C.I.12517 | 14 | 6 | 15 | 9 | 18 | 16 | 24 | 15 | 29.2 |
| Comanche x Blkh.-Hd.Fed. | W 43h 2-329 | 12 | 4 | - | - | - | - | - | 8 | 29.5 |
| Kiowa | C.I.12133 | 14 | 5 | 12 | - | - | - | - | 10 | 30.1 |
| Marmin x H44-Minturki ² | M 2794 | - | - | 15 | - | - | - | - | 15 | 30.4 |
| Comanche sel. | St 473257 | - | - | - | - | - | - | 20 | 20 | 30.8 |
| Wichita x Mqo.-Oro | T 218-44-27 | - | - | - | - | - | - | 20 | 20 | 31.2 |
| Kiowa x Mqo.-Oro | C.I.12994 | - | - | - | - | 17 | 20 | 25 | 21 | 31.3 |
| Sioux | C.I.12142 | - | - | - | 22 | 13 | 27 | - | 21 | 32.5 |
| Mqo.-Oro x Comanche | K 452363 | - | - | - | 19 | - | - | - | 19 | 33.0 |
| Hope-Ridit x Nebred | N 442998 | - | - | 16 | - | - | - | - | 16 | 33.5 |
| Comanche Doublecross | T 171-44-82 | 10 | - | - | - | - | - | - | 10 | 33.8 |
| Marmin x H44-Minhardi | C.I.12704 | - | - | 16 | - | - | - | - | 16 | 33.9 |
| Med.-Hope x Pawnee ² | K 251 | - | - | - | - | 20 | - | - | 20 | 34.9 |
| Comanche x Chey.-Blkh. | W 43h. 3-81 | 14 | 8 | 15 | 21 | - | - | - | 14 | 35.5 |
| Chiefkan x Martin-Tq. | C.I.12146 | 14 | 5 | 18 | - | - | - | - | 12 | 35.8 |
| Kawvale-Tq. x Comanche | C.I.12524 | 13 | 8 | 17 | - | - | - | - | 12 | 35.8 |
| Mqo.-Oro x Pawnee | C.I.12505 | 8 | 11 | 19 | - | - | - | - | 13 | 36.7 |
| Comanche Doublecross | T 171-44-159 | 12 | - | - | - | - | - | - | 12 | 39.1 |
| Chiefkan x Oro-Tq. | HC 46-49 | 12 | - | - | - | - | - | - | 12 | 41.1 |
| Marmin x H44-Minhardi | C.I.12508 | - | - | 20 | - | - | - | - | 20 | 42.4 |
| Chiefkan x Oro-Tq. | HC 46-64 | 13 | - | - | - | - | - | - | 13 | 43.1 |
| Chiefkan x Oro-Tq. | HC 46-41 | 13 | - | - | - | - | - | - | 13 | 43.5 |
| 275 Doublecross | C.I.12511 | 13 | - | - | - | - | - | - | 13 | 43.5 |
| 275 Doublecross | T 172-43-211 | 13 | - | - | - | - | - | - | 13 | 43.8 |
| Turkey-Tq. x Chey.-Turk. | C.I.12523 | - | - | 21 | - | 22 | - | - | 22 | 44.7 |
| Chiefkan x Oro-Tq. | C.I.12148 | 13 | - | - | - | - | - | - | 13 | 44.8 |
| H44 x Minturki ² | M II-40-56 | - | - | - | 25 | - | - | - | 25 | 45.2 |
| Comanche | C.I.11673 | 14 | - | - | - | - | - | - | 14 | 45.5 |
| Chiefkan x Oro-Tq. | HC 46-52 | 14 | - | - | - | - | - | - | 14 | 45.8 |
| Chiefkan x Oro-Tq. | HC 46-53 | 14 | - | - | - | - | - | - | 14 | 45.8 |
| H44 x Minturki ³ | M 2784 | 22 | 5 | - | - | - | - | - | 14 | 48.9 |
| Kiowa x Mqo.-Oro | K 52 H 1024 | - | - | - | - | - | 20 | 32 | 26 | 36.3 |
| Hope x Minturki ² | M 2724 | 15 | - | - | - | - | - | - | 15 | 50.2 |
| Chey.-Chief.xH44-Mint. ² | M 2863 | - | - | - | - | - | - | 36 | 36 | 55.6 |
| H44-Minhardi x Marmin | M 192785 | 17 | - | - | - | - | - | - | 17 | 58.2 |
| Med.-Hope x Comanche ² | K 50266 | - | - | - | - | 33 | - | - | 33 | 58.8 |
| Nebred x Hope-Turk. | N 456812 | - | - | 30 | - | - | - | - | 30 | 61.1 |

Table 1 (Continued)

| Variety or cross | C.I. or state no. | 1948 | 1949 | 1950 | 1951 | 1952 | 1953 | 1954 | Wt. Av. | Percent- age of Kharkof |
|--|----------------------|------|------|------|------|------|------|------|------------|-------------------------------|
| Orienta | C.I.12522 | - | 10 | 36 | - | - | - | - | 23 | 62.1 |
| Marmin x H44-Minhardi | C.I.12520 | - | - | 32 | - | - | - | - | 32 | 66.7 |
| Comanche x Med.-Hope | K 44712 | 20 | - | - | - | - | - | - | 20 | 68.2 |
| Med.-Hope-Pn. x Oro-Ill. 1-Com. | C.I.12804 | - | - | - | - | 31 | 42 | 62 | 45 | 68.6 |
| Minturki | C.I.6155 | 16 | 7 | 13 | 23 | 16 | 26 | 17 | 17 | 68.6 |
| Chiefkan x Mint.-Tq. | T 160-49A13 | - | - | - | - | - | - | 45 | 45 | 68.8 |
| Chey.-Chief. x H44-Mint. ² | M II-44-8 | - | - | - | - | - | - | 46 | 46 | 71.1 |
| Oro x Blkh.-Hd.-Fed. | C.I.13001 | - | - | - | - | 40 | 49 | 53 | 48 | 73.0 |
| Kawvale-Tq. x Comanche | C.I.12149 | 22 | - | - | - | - | - | - | 22 | 73.9 |
| H44-Minhardi x Marmin | C.I.12508 | 22 | - | - | - | - | - | - | 22 | 74.6 |
| H44-Minturki ² | M II-40-54 | - | - | - | 42 | - | - | - | 42 | 74.6 |
| Westar x Hope-Turkey | T 253-48-21 | - | - | - | - | - | - | 49 | 49 | 75.7 |
| Ponca | C.I.12128 | - | - | - | 48 | 40 | - | - | 43 | 76.6 |
| Blackhull-Oro-Pawnee | W 43h1-94 | 25 | - | - | - | - | - | - | 25 | 82.3 |
| Blackhull-Oro-Pawnee | W 43h1-236 | - | - | - | - | - | 58 | 64 | 61 | 87.4 |
| Westar sel. | C.I. 13090 | - | - | - | - | - | - | 58 | 58 | 88.9 |
| Westar sel. | St 483658 | - | - | 44 | - | - | - | - | 44 | 90.6 |
| Hope-Turk. x Turkey | C.I.12712 | - | - | 45 | - | - | - | - | 45 | 92.7 |
| Med.-Hope-Pn.xOro-Ill. 1-Com. | K 49383 | - | - | - | - | 53 | - | - | 53 | 92.9 |
| RedChief-Oro-Turk.-Flor. x Mqo.-Oro | T 240-48-11 | - | - | - | - | - | - | 62 | 62 | 96.3 |
| Cheyenne | C.I. 8885 | 35 | 31 | 45 | 54 | 52 | 70 | 62 | 50 | 98.6 |
| Westar sel. | St 483664 | - | - | 48 | - | - | - | - | 48 | 99.0 |
| Kharkof | C.I.1442 | 30 | 26 | 48 | 56 | 57 | 74 | 65 | 50 | 100.0 |
| Nebred x Com.-Med.-Hope | K 46 R 693-4 | - | - | 50 | - | - | - | - | 50 | 103.7 |
| 275 Doublecross | C.I.12503 | 31 | - | - | - | - | - | - | 31 | 104.7 |
| Nebred x Com.-Med.-Hope | K 46 R 693-6 | - | - | 54 | - | - | - | - | 54 | 112.1 |
| Iohardi | C.I.12510 | - | 36 | 50 | 60 | - | - | - | 47 | 113.6 |
| Triticum x A. elongatum | C.I.12720 | - | - | 55 | - | - | - | - | 55 | 113.7 |
| Comanche x Chiefkan | K 45309 | 35 | - | - | - | - | - | - | 35 | 116.1 |
| Wichita x Mqo.-Oro | W 487067 | - | - | - | - | - | - | 76 | 76 | 117.2 |
| KanKing | C.I.12719 | - | - | - | - | - | - | 81 | 81 | 124.6 |
| Minturki x H44-Minhardi | M 2786 | 41 | - | - | - | - | - | - | 41 | 136.6 |
| Gimarron | C.I.12120 | - | 37 | - | - | - | - | - | 37 | 142.8 |
| RedChief | C.I.12109 | 58 | 53 | 80 | 70 | 84 | 85 | 84 | 73 | 146.6 |
| Comanche x Chey.-Blkh. | W 43h3-85 | 45 | - | - | - | - | - | - | 45 | 150.0 |
| Reliant 32 | 68 B 32 | - | 53 | - | - | - | - | - | 53 | 203.8 |

Ridit and 77 selections more resistant than Relief, the two other highly resistant checks. It should be noted that crosses with Oro-Turkey-Florence, Hussar-Hohenheimer, and C.I. 12250 in their parentage as well as lines of the crosses Yogo x Wasatch, Turkey x Oro, and Yogo x Rescue are prominent in this group of selections.

The Ridit variety retained its resistance very well throughout the 7 years of the present studies. In no year did its average exceed 4.0 percent, and it was only a trace in 1951 and an average of only 1 percent in four other years.

Relief, another resistant variety, gave variable results. The average percent infection for Relief was 5 percent or less in 1948, 1949 and 1950 but it suddenly rose to 13 percent in 1951 and has remained at about that level since that time. This was due to unusually high infections on Relief at Manhattan, Kans., and Stillwater, Okla. A collection of bunt was made in Relief at Stillwater, Okla. in 1951 and sent to C. S. Holton for physiologic race determination. This revealed the presence of race L7, which is known to produce heavy infections on Relief. Race L7 was one of the constituents of the composite used at Manhattan, Kansas since 1950. The presence of L7 in the inoculum also explains the relatively high infections on Hussar in 1953 and 1954, particularly at Stillwater and Manhattan. Hussar is one of the parents of Relief.

Another point of interest was the reaction of the moderately resistant variety Oro. This variety consistently showed low percentages of common bunt at stations in the Great Plains area from 1948 through 1952, but had higher infections at Bozeman, Mont., where L8 and some races of Tilletia caries were used in the inoculum. However in 1953 the percentage of infection for Oro suddenly rose to 75 percent at Fort Collins, Colorado. Infection on Oro at Fort Collins was 23 percent in 1954. The sudden rise in the infection in Oro at Fort Collins undoubtedly is due to the presence of physiologic race L8 in the inoculum used at that station. L8 was present in the composite inoculum used at Fort Collins in 1941 and 1942 but apparently not from 1947 to 1952.

Of the three susceptible checks RedChief had the highest infection, followed by Kharkof and Cheyenne. Kharkof is used as the basis of comparison of all varieties because it has been a standard check variety in nearly all experiments with hard red winter wheat. RedChief was exceeded in susceptibility by Kanking (81.0 percent) and Wichita x Marquillo-Oro W 487067, and 13 varieties and selections had higher average infections than Kharkof in the same years. Only 20 of the 364 varieties tested had average infections above 40 percent which is the arbitrary lower limit of susceptibility.

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It is clearly evident from the data in table 1 that there are a large number of hard red winter wheat selections which have moderate to strong resistance to many races of common bunt. These derived their resistance principally from varieties such as Oro, Minturki, and selections of Turkey. The resistant selections arise from crosses made at many agricultural experiment stations, chiefly those in Kansas, Nebraska, Montana, Minnesota, and Oklahoma. The effort to control bunt in hard red winter wheat has been both widespread and successful.

Results with Dwarf Bunt

The tests with dwarf bunt in the field at Spring Hill, Mont., where the soil was naturally contaminated, were erratic and mostly unsatisfactory. Data were recorded in only 5 of the 7 years in which the dwarf bunt nurseries were sown. No data could be obtained in 1949. The 1952 nursery was destroyed by snow mold, and this disease also affected results in other years, especially 1951. Certain strains were lost from winter killing or other causes in most of the years.

Selections showing resistance to dwarf bunt, together with certain check and parental varieties are listed in table 2. The resistance of some of these is doubtful because of the low level of infection as shown by susceptible check varieties may have permitted certain strains to escape. Certain varieties and certain crosses have outstanding resistance to dwarf bunt. Wasatch was the most resistant variety, showing no bunt in any of the four years it was tested. Relief and Hussar also had high resistance to dwarf bunt in these tests.

Crosses with Oro-Turkey-Florence, Hussar-Hohenheimer and C.I. 12250 in their parentage were outstanding for resistance. Several selections of Yogo x Wasatch, Turkey x Oro, Ridit x Kharkof and Yogo x Rescue had low infection. Many selections with Oro as the only obvious source of resistance in the parentage were more resistant than Oro. Minturki also apparently contributed resistance since many selections with Minturki in the parentage also were resistant to dwarf bunt. One selection of Kharkof was highly resistant while a Comanche selection was only moderately resistant. Kiowa in a single experiment was bunt free, and Sioux, also tested in a single year, was moderately resistant. Judging by the infection percentages, sources of resistance to dwarf bunt in hard red winter wheat seem to be abundant. One selection of Marquillo-Oro x Oro-Turkey-Florence has been increased so seed will be available for growers should dwarf bunt cross the Rocky Mountains and invade the plains of Kansas.

A more positive test for probable resistance to dwarf bunt is that devised by C. S. Holton who discovered that reaction to dwarf bunt and to physiologic race TL6 was practically the same in most wheat varieties and selections. With this in mind a number of promising bunt resistant selections of hard winter wheat were sent to Pullman, Wash., for tests

Table 2. Dwarf bunt in certain selections of hard red winter wheat grown in infested soil at Spring Hill, Montana, 1948-1954.

| | C.I. or state no. | 1948 | 1950 | 1951 | 1953 | 1954 | Average |
|------------------------------------|-------------------------|------|------|------|------|------|---------|
| Wasatch | 11925 | | 0 | 0 | 0 | 0 | 0 |
| Ridit | 6703 | 18 | 3 | | 0 | 1 | 6 |
| Relief | 10082 | 1 | 0 | | 0 | 1 | 1 |
| Hussar | 4843 | 2 | 0 | | 0 | 1 | 2 |
| Mgo.-OroxHussar-Hohen. | K47B52 | 3 | | | | | 3 |
| Ditto | 12724 | | 0 | | | | 0 |
| Mgo.-OroxOro-Turk.-Flor. | 12723 | 2 | 0 | T | | | 1 |
| Ditto | 12721 | 3 | | | | | 3 |
| Ditto | 12722 | 4 | 0 | 1 | | | 2 |
| Ditto | 12937 | | | 2 | | | 2 |
| Ditto | 12938 | | | 1 | | | 1 |
| Ditto | 12939 | | | 1 | | | 1 |
| Ditto | 12865 | | | | 1 | | 1 |
| Ditto | NP.48500 | | 1 | | | | 1 |
| OroxOro-Turk.-Flor. | K47B157 | 0 | | | | | 0 |
| Ditto | 12941 | | | 1 | | | 1 |
| Ditto | 12942 | | 0 | 1 | | | 1 |
| Ditto | 12866 | | | 5 | | | 5 |
| ComanchexOro-Turk.-Flor. | 12725 | | 0 | 1 | | | 1 |
| Ditto | K47B160 | | | 1 | | | 1 |
| Mgo.-OroxPawnee | K45R2024 | 3 | | | | | 3 |
| Ditto | K462681 | | 5 | | | | 5 |
| Ditto | K462666 | | 0 | | | | 0 |
| ChiefkanxMartin-Tenm. | 12146 | 2 | | | | | 2 |
| Oro | 8220 | 18 | 5 | | 5 | 10 | 10 |
| Yogo | 8033 | | 11 | | | | 11 |
| Yogo x Wasatch | M3 | | | T | 0 | | T |
| Ditto | M4 | | | 0 | 0 | | 0 |
| Ditto | M6 | | | 1 | 0 | | 1 |
| Ditto | M8 | | | 4 | 1 | | 3 |
| Ditto | M9 | 0 | 0 | | | | 0 |
| Ditto | M10 | 0 | 0 | | | | 0 |
| Ditto | M11 | 0 | T | | | | T |
| Turkey x Oro | 12705 | | 0 | 1 | | | 1 |
| Ditto | M216 | | 0 | | | | 0 |
| Ditto | M205 | | 0 | T | | | T |
| Ditto | M201 | | 0 | | | | 0 |
| Ditto | M208 | | 0 | | | | 0 |
| Ridit x Kharkof | M11B | | 0 | | | | 0 |
| Ditto | M5B | | 2 | | | | 2 |
| Ditto | 12521 | | 5 | | | | 5 |
| Mgo.-Oro x Comanche | K431646 | | 2 | | | | 2 |
| Mgo.-OroxOro-Tenmarq | 12406 | | 0 | | | | 0 |
| 29-34-275 D.C. | 12511 | | 1 | | | | 1 |
| Kiowa | 12133 | | 0 | | | | 0 |
| E.Blkh.-Tq.xOro-Med.-Hople | 12871 | | 5 | | 10 | 10 | 8 |
| Marmin x H44-Minturki ² | M2794 | | 5 | | | | 5 |

Table 2 (Continued)

| | C.I. or state no. | 1948 | 1950 | 1951 | 1953 | 1954 | Average |
|---|-------------------------|------|------|------|------|------|---------|
| Nebred x C.I.12250 | N50J1323 | | | 0 | | | 0 |
| Ditto | N522126 | | | | | 1 | 1 |
| Ditto | N522121 | | | | | 5 | 5 |
| Ditto | N522123 | | | | | 1 | 1 |
| Cheyenne x C.I.12250 | N522108 | | | 0 | | 10 | 5 |
| Comanche x C.I.12250 | N50J1129 | | | 0 | | | 0 |
| Ditto | N50J1067 | | | 0 | | | 0 |
| Ditto | 13013 | | | | | 5 | 5 |
| Ditto | N521126 | | | | | 5 | 5 |
| Pawnee x C.I. 12250 | N51J5 | | | 0 | | | 0 |
| Ditto | N521111 | | | 0 | | | 0 |
| Ditto | N521108 | | | 0 | | | 0 |
| Ditto | 13010 | | | | | 1 | 1 |
| Ditto | 13012 | | | | | 0 | 0 |
| Ditto | 13009 | | | | | 1 | 1 |
| Ditto | 13011 | | | | | 5 | 5 |
| Ditto | N522145 | | | | | 5 | 5 |
| Yogo x Rescue | Mt.56-30 | | | | | 0 | 0 |
| Ditto | Mt.47-3 | | | | | 5 | 5 |
| Wheat-rye-A.elong.x Cheyenne | 13114 | | | | 0 | 1 | 1 |
| (Mqo.-Oro x Oro-Tq.) x Med.-Hope-Pn. | 12868 | | | | 1 | | 1 |
| Mqo.-Oro x Oro-Tq. | 12854 | | | | 5 | | 5 |
| Wichita x (Mqo.-Oro x Kv.- Tenmarq) | 51H2042 | | | | 5 | | 5 |
| Wichita-H44-Mint. ² x M.- Ts.-Kh. | 12867 | | | 0 | | | 0 |
| Mint. x Tim.-Vulg. ² | 12806 | | | | | 1 | 1 |
| H44 x Minturki ⁴ | M2844 | | | | | 1 | 1 |
| H44-Mint.xK-H.F.-Tq. MII-44-67 | | | | | | 5 | 5 |
| Chey.-Chf.xH44-Mint. ² MII-44-8 | | | | | | 5 | 5 |
| IV Cl-Com. x Pn.-Com. K472941 | | | | | 1 | 10 | 6 |
| Comanche sel. Stw.473257 | | | | | 10 | 15 | 13 |
| Kiowa x Mqo.-Org | 12994 | | | | 5 | 10 | 8 |
| Med.-Hope x Pn. ² | 12873 | | | | 10 | | 10 |
| Sioux | 12142 | | | | 10 | | 10 |
| Chey.-R.Chf. x Pn.- Mqo.-Oro | N521455 | | | | | 5 | 5 |
| Wichita x M.-O.K.-T. K51H2042 | | | | | | 5 | 5 |
| Comp.hyb. x Mqo.-Oro | N502984 | | | | | 10 | 10 |
| Kharkof sel. Mt.17-7 | | | | | | 0 | 0 |
| Chf. x Mart.- Tq. Tx160-49-A13 | | | | | | 1 | 1 |
| Kharkof Ck. 1442 | | 25 | 50 | 22 | 25 | 25 | 29 |

Table 3. Reaction of some promising selections of hard red winter wheat to the tester race of bunt T16.

| | C.I. or ser. no. | Percent bunt |
|-----------------------------|------------------------|-----------------|
| Year | | |
| <u>1951</u> | | |
| Yogo | 8033 | 35 |
| Wasatch | 11925 | 0 |
| Yogo x Wasatch | Mt. 3 | 0 |
| Ditto | Mt. 4 | 0 |
| Ditto | Mt. 6 | 1 |
| Ditto | Mt. 8 | 0 |
| Ditto | Mt. 9 | 0 |
| Ditto | Mt. 10 | 0 |
| Ditto | Mt. 11 | 0 |
| Mgo.-Oro x Oro-Turk.-Flor. | 12721 | 0 |
| Ditto | 12722 | 0 |
| Ditto | 12937 | 0 |
| Ditto | 12938 | 0 |
| Ditto | 12723 | 0 |
| Ditto | 12939 | 2 |
| Ditto | N.P. 48505 | 3 |
| Comanche x Oro-Turk.-Flor. | K47BB9 | 0 |
| Ditto | K47B160 | 0 |
| Oro x Oro-Turk.-Flor. | 12941 | 5 |
| Ditto | 12942 | 0 |
| Ditto | N. 141333 | 3 |
| Mgo.-Oro x Hus.-Hohenheimer | 12724 | 3 |
| Turkey x Oro | Mt. 208 | 0 |
| Ditto | Mt. 216 | 2 |
| Ditto | Mt. 201 | 0 |
| Ditto | Mt. 205 | 2 |
| Ditto | 12705 | 0 |
| Mgo.-Oro x Pawnee | K462666 | 7 |
| Kharkof | 1442 | 74 |
| <u>1954</u> | | |
| Pawnee x C.I. 12250 | 53465 | 9 |
| Ditto | 532042 | 5 |
| Ditto | 532044 | 7 |
| Ditto | 521115 | 5 |
| Kharkof | 1442 | 93 |

with T16 in 1951 and 1954. The results are summarized in table 3. The infection in the Kharkof check was very heavy each year and some selections also had high infections, so it is felt that these results are reliable. They indicate the presence of good resistance to dwarf bunt in many hard winter wheats.

Summary

Uniform bunt nurseries were grown at from 4 to 7 agricultural experiment stations in the central United States during each year the period 1948-1954. At most of the stations the seed was inoculated before sowing with composites of spores of physiologic races of common bunt. At Spring Hill, Mont., clean seed was sown in soil infested with dwarf bunt. Many of the hybrid selections being tested in the hard red winter wheat area appear to be resistant to common and dwarf bunt. Many selections from crosses involving Oro-Turkey-Florence, Hussar x Hohenheimer, and C.I. 12250, and from the crosses Yogo x Wasatch, Turkey x Oro, and Yogo x Rescue, had excellent resistance to common bunt. Many of the same lines also were resistant to dwarf bunt. A high degree of resistance apparently has been obtained from the varieties Oro, Turkey, and Minturki. One selection of Marquillo-Oro x Oro-Turkey-Florence has been increased in Kansas and the seed is being held in reserve for release in the event dwarf bunt moves east of the Rocky Mountains onto the plains of Kansas.

with this in 1951 and 1952. The results are summarized in Table 3. The infection in the blattal check was very heavy each year and some selections also had high infections, so it is felt that these results are reliable. They indicate the presence of good resistance to dwarf bunt in many hard winter wheats.

Summary

Uniform bunt nurseries were grown at from 1 to 7 agricultural experiment stations in the central United States during each year the period 1948-1952. At most of the stations the seed was inoculated before sowing with a mixture of spores of physiologic races of common bunt. At Harting Hill, Mo., a seed was sown in soil infected with dwarf bunt. Many of the hybrid selections being tested in the hard red winter wheat area appear to be resistant to common and dwarf bunt. Many selections from crosses involving Oro-Turkey, Florence, Kansas x Hohentanne, and O.T. 14550, and from the crosses Yogo-Wassah, Turkey x Oro, and Yogo x Kansas, had excellent resistance to common bunt. Many of the same lines also were resistant to dwarf bunt. A high degree of resistance apparently has been obtained from the varieties Oro, Turkey, and Hohentanne. One selection of Maryland-Oro x Oro-Turkey-Florence has been increased in Kansas and the seed is being held in reserve for use in the event dwarf bunt moves east of the Rocky Mountains onto the plains of Kansas.

